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ABSTRACT

The academic training needs of two-year college mathematics faculty are discussed in this paper and appropriate courses of study are proposed. After introductory comments on the diversity of two-year college students' needs for mathematics education, an undergraduate course of study appropriate for two-year college math faculty is proposed. This includes courses in heuristics and problem solving, discrete mathematics, calculus, computing, math appreciation, linear algebra, probability and statistics, number theory, geometry, abstract algebra, the history of mathematics, mathematical modeling and applications, and, for teachers of calculus, an advanced calculus course. Arguing that the master's degree should be the basic requirement for two-year college math faculty, the next section recommends a graduate pre-service program with a heavy concentration on mathematics and course work in professional education. Suggested courses focus on problem solving, linear algebra, advanced calculus, advanced differential equations, applied math, mathematical modeling, computing, teaching methods, a special project requiring independent research and careful exposition, and an extensive internship at a two-year college. Suggesting that the Doctor of Arts degree is an appropriate objective for two-year college math faculty seeking a doctorate, the paper then outlines the requirements of the Doctor of Arts degree at Washington State University, highlighting the importance of concentration on mathematics and math education rather than professional education. Finally, the need for professional continuing education is underscored. (HB)

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THE ACADEMIC TRAINING OF TWO-YEAR COLLEGE MATHEMATICS FACULTY

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ABSTRACT

This article discusses the academic training of two-year college faculty. Courses of study are proposed for baccalaureate and master's degrees for such faculty and it is proposed that the basic requirement for two-year college faculty be the master's degree. The structure of an existing Doctor of Arts degree is also discussed and it is suggested that two-year college faculty, whatever their background, should be involved in continuing education activities on a regular basis.

1. Introduction. The two-year college system in America is essentially unique. Other countries have educational institutions with goals that overlap those of America's two-year colleges, but they tend to have a more limited focus and are not nearly so ubiquitous as two-year colleges in this country. Indeed, these facts are, to a large extend, the raison d'etre of the present conference. The rapid growth of the two-year college system and the wide diversity of goals among the various schools makes it clear that their mission is not well defined. Hopefully, one result of the present conference will be a clarification or re-definition of the appropriate role and mission of American two-year colleges that will be helpful not only to existing institutions but also to those to be established in the near future.

On the one hand, the diversity in the present system is not necessarily bad since a diversity of important educational objectives need to be and are being addressed. On the other hand, this same diversity makes it difficult to know how best to prepare faculty to staff two-year institutions. Preparing teachers to teach the mathematics required in a two-year transfer program is quite different from preparing teachers to deal with masses of students requiring instruction in remedial mathematics or requiring instruction suitable for preparation for various vocations. This poses a difficult problem for institutions preparing future two-year college faculty as well as for the future faculty themselves. What training is the most suitable? How can the needs of these future faculty best be met? I am not at all sure that I have the answer, but I will at least address the problem in what follows. Hopefully, some of the suggestions will have merit; at least they can serve as a point of departure for further discussion.

While this paper deals primarily with preservice preparation, at least brief mention will be made of the in-service or continuing eduation needs of two-year college faculty. The very title of this conference, "New Directions in

Two-Year College Mathematics," is recognition of the fact that the mathematics needs of two-year college students are changing and this clearly implies a need for reorientation and updating of present faculty.

2. Undergraduate Preservice Preparation. As noted in the study of McKelvey, Albers, Liebeskind, and Loftsgaarden [1], in excess of 60% of present two-year college faculty have had extensive experience as high school teachers. In view of the remedial responsibility of two-year colleges and, to a large extent, their role in vocational training, the high school experience does not seem inappropriate. Students in these programs have special needs, and extensive experience in high school surely provides insights and develops skills that allow faculty to better deal with these needs. In any case, the undergraduate training of prospective two-year college teachers should at least meet the requirements for high school teachers detailed in the recent recommendations of the CUPM Panel on Teacher Training of the Mathematical Association of America [3]. In brief the requirements in mathematics would include the content of the following thirteen courses where a "course" is defined as one of three semester-hours duration:

i) Discrete mathematics
ii) Calculus Sequence (three courses)
iii) Introduction to Computing
iv) Mathematics appreciation
v) Linear Algebra
vi) Probability and Statistics
vii) Number theory
viii) Geometry
ix) Abstract Algebra
x) History of Mathematics
xi) Mathematical Modeling and Applications

Detailed descriptions of these courses can also be found in the Recommendations cited. (See also the guidelines of the National Council of Teachers of Mathematics [2], especially page 11.)

Beyond this, the Recommendations go on to state that "teachers of calculus should have additional work in analysis including the background for teaching the content of the Advanced Placement Calculus." This is to say that teachers of calculus should have had differential equations, and at least one course in advanced calculus.

Finally, with regard to content, I would recommend that the undergraduate program include at least one course in heuristics and problem solving. In many ways, this may be the most important requirement of all. If we can teach students the art of problem solving or, as someone has said, if we can develop thoughtful mathematical behavior in students, then all other mathematical goals will be much more easily attained. After all, the only reason for doing mathematics (of whatever variety) is to solve problems. That is what mathematics is all about!

Of course, the above recommendations only deal with mathematics content which, while necessary, is not sufficient. In addition, two-year college teachers should be broadly educated generally and should also receive instruction in the craft and art of teaching. Thus, in addition to specific knowledge of mathematics and a broad general education, two-year college teachers should be familiar with various approches to teaching mathematics, with learning theory, with evaluation, with diagnosing and, particularly, remedying student deficiencies in the learning of mathematics. In order for these competencies to be attained it is imperative that institutions provide appropriate course work. In particular, provision must be made for the application of these studies to mathematics instruction through suitable courses in mathematics education including at least one course in methods of teaching mathematics at the two-year college level [see 3, pp. 12-13].

3. Graduate Preservice Preparation. While what is outlined above is substantial, it is necessarily inadequate. The minimum degree requirement for two-year college mathematics teaching should be a master's degree. The degree could have any one of several designations indicated by the abbreviations M.A., M.S., or M.A.T., all in mathematics, or even M. Ed. But, in any case, like the baccalaureate degree just described, it should include a heavy concentration in mathematics content and also additional course work in professional education. I would recommend an additional course in problem solving, a second semester of linear algebra, a second semester of advanced calculus, advanced differential equations, applied mathematics, mathematical modeling, computing, advanced methods of teaching mathematics, a master's special project, and an extensive internship at a two-year college. The master's special project could be pedagogical but it might also be an indepth study of some particular topic like simple continued fractions or recurrence relations. Here students should be expected to dig out material on their own with little assistance from an instructor and also to write up a reasonable account of what has been learned. The last is particularly important. Two-year college faculty need to be confident of the fact that they can read and learn new mathematics on their own, and they also need to develop skill at careful exposition.

Finally, the additional methods course (properly constructed and effectively taught) and particularly the internship (properly supervised) should go a long way toward perfecting the prospective faculty member's skill as a teacher and enhancing his/her understanding of the appropriate role of the two-year college teacher. Beyond that, this experience, as much as any other, should help to instill in the candidate a sense of mission and a high degree of professionalism.

Incidentally, those students who desicde to go into two-year college teaching after dropping out of Ph.D. programs should be required by hiring institutions to submit credentials equivalent to what has just been detailed for the undergraduate and master's training of such faculty. In particular, they should be required to take undergraduate and graduate courses in learning theory, evaluation, diagnosing

and remedying student deficiencies, and methods which they would not normally take otherwise. They should also be expected to complete an internship in a two-year college as discussed above.

4. The Doctor of Arts Degree. As reported by McKelvey, *et al* [1], an increasing number of two-year college teachers are seeking the doctorate. This is all to the good. But the degree should be especially designed and should probably be something other than the Ph.D. A number of graduate schools have settled on the Doctor of Arts designation while others use Doctor of Mathematics Education, Doctor of Science Education, or some form of the Ed. D. Whatever the designation, the degree should have a heavy concentration of mathematics and mathematics education courses as opposed to courses in professional education.

The aim of the degree program should be to produce a highly professional teacher of two-year college mathematics who is broadly knowledgeable in mathematics and is also an expert practitioner of the craft of teaching in all its aspects as it applies to two-year colleges. Such a teacher should be a leader on his/her campus, should be involved in professional organizations, and should be continually involved in devising new and more appropriate curricula and teaching strategies. Such a teacher should also be actively promoting the profession and publishing as appropriate in suitable journals.

Programs leading to the Doctor of Arts or similar degrees exist at a number of institutions. On my own campus, it is a high level degree similar to the Ph.D. and yet with notable exceptions. Briefly, the requirements are as follows:

1) Forty-five hours of graded courses including nine hours of combined linear algebra and analysis (advanced linear algebra, calculus on E^n, basic complex analysis, harmonic functions, metric spaces, integration, Hilbert spaces, Fourier and Laplace transforms, special functions, and group representations) and twenty-four hours chosen from among a large selection of graduate level courses in pure and applied mathematics and statistics.

ii) One semester courses in numerical analysis and foundations of mathematics, a two-semester seminar on the history of mathematics, and a seminar in undergraduate mathematics instruction.

iii) Two advanced courses in a department other than mathematics are recommended; the courses should draw heavily on mathematics and illuminate its place in science and society.

iv) A course in computer organization and programming, one in program design and development, and at least one more advanced computing course. Computing is expected to be a continuing and vital part of the mathematical repertoire of every candidate for the Doctor of Arts degree. Particular emphasis should be placed on the use of small computers and other aspects of computer science most likely to be useful to a teacher at a two-year college.

v) Advanced educational psychology.

vi) An advanced education course concerned with the history, sociology, and philosophy of higher education. Possibilities on our campus include The Community and Junior College, Undergraduate and Community College Teaching, and the American College and University.

vii) A minimal proficiency is required in two foreign languages—French, German or Russian.

viii) Each DA student is required at some time during the program to be responsible, under supervision, for teaching at least one undergraduate mathematics class for a semester.

xi) The student is strongly recommended to spend at least one quarter as an intern (i.e., as a full-time teacher) at a two-year college under close supervision by someone in that college and by a member of the faculty at Washington State University.

x) A thesis is required. This may embody an original contribution to mathematics, but normally will be a scholarly dissertation which could be historical, critical, or philosophical in nature, or deal with suitable problems in mathematics education. In the latter case, the emphasis will be on mathematical scholarship. Studies devoted primarily to surveys, curriculum construction, experimental teaching techniques, and the like will probably not be acceptable. The thesis should exhibit considerable learning, insight, and skill in exposition.

Our department has never pushed the Doctor of Arts program with vigor and only one student, currently teaching in a four year college, has completed the degree thus far. However, the department is now giving the degree increased emphasis and six students, some of whom are contemplating careers in two-year colleges, are presently enrolled in the program. My own opinion is that our degree is perhaps too near the Ph.D. and that it might well include less ultra-sophisticated mathematics which has little relationship to what goes on in two-year colleges. To put it the other way around, it might well include more course work in curriculum development, on teaching strategies—particularly for remediation and for teaching vocational mathematics, on problem solving and the teaching of problem solving, and on applications relevant to the two year college scene. Also, significant theses devoted to curriculum development and to the development of new teaching strategies ought not be viewed as exceptional as they presently are.

5. Continuing Education for Faculty. There are many reasons why continuing education or continuing development activities are a must for two-year college faculty (as, indeed, they are for teachers of every level—K through university).

In the first place, increasingly rapid change, orderly and disorderly, haphazard and reasoned, is the hall mark of our times and the implications of this fact are obvious to us all. In order to keep abreast of the times, teachers at every level need to be heavily engaged in seminars, workshops, short courses,

conferences, and professional meetings. We also need to be reading a seemingly endless array of professional papers, pamphlets, books, and periodicals. How else can we be appraised of the latest develoments in mathematics, in the teaching of mathematics, in the application of mathematics, in computing and the relationship between computing and the subject matter of mathematics, and in the use of computers in the teaching of mathematics, etc., etc.? The need to know and to keep abreast is dramatic and compelling. There is no denying these facts. To attempt to hold the line is, in fact, to fall hopelessly behind.

But there is another, and it seems to me, even more compelling reason for teachers to study and to continue to expose themselves to new ideas in their particular area of interest and expertise. Teaching is at once a satisfying and enriching task and also an extremely enervating one. Good teaching requires the regular expenditure of enormous amounts of nervous, mental, and physical energy, and we are all aware of the large numbers of teachers who leave the profession because of "burn out." Differently put, good teaching requires the maintenance of a high level of enthusiasm on the part of the teacher. Like the old cliché of leading a horse to water but being unable to make him drink, it has been said that it is impossible to teach a student anything. On the other hand, it *is* possible for an adroit and enthusiastic teacher to inspire a student to want to learn and to do so successfully. This is at once the task, the challenge, and the reward of the teacher.

In short, I claim that we teachers can only maintain our zest for mathematics and our ability to inspire in our students a desire to learn mathematics, by continually investigating new topics in mathematics *for ourselves*. Not because we expect to turn around and present these ideas to our students, not because such study is necessary if we are to keep abreast of the times, but because such activity is essential for the maintenance of our own personal mathematical well-

being, because we want to allow ourselves continually to be confronted afresh with the unexpected delights and subtleties of new mathematical ideas. If you please, what I am saying is that we teachers of mathematics continually need mathematical enrichment experience *for ourselves* and that obtaining such experience is worth the expenditure of a considerable amount of time and effort. There, of course, is the rub; for we are all only too well aware of the demands modern life makes on our time and energy. But the prize is worth the cost and, if we are to stay alive and active as teachers, the effort simply must be made.

The Indian philosopher Tagore summed the matter up very well when he penned the following words:

> A teacher can never truly teach unless he is still learning himself. A lamp can never light another lamp unless it continues to burn its own flame. The teacher who has come to the end of his subject, who has no living traffic with his knowledge but merely repeats his lessons to his students, can only load their minds; he cannot quicken them. Truth not only must inform, but must inspire. If the inspiration dies out and the information only accumulates, then truth loses its infinity (and the teacher loses his effectiveness).*

*Parenthetical expression added by the present author who has also lost the reference on this quotation. If any reader knows it, please notify the author.

REFERENCES

1. Robert McKelvey, Donald Albers, Shlomo Libeskind, Don Loftsgaarden, An Inquiry Into the Graduate Training Needs of Two-year College Teachers of Mathematics, The Rocky Mountain Consortium, 1979.
2. Guidelines for the Preparation of Teachers of Mathematics, National Council of Teachers of Mathematics, Reston, 1981.
3. Recommendations on the Mathematical Preparation of Teachers, The Mathematical Association of America, Washington, 1983.

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